IWSFG Template for Reviewer comments and IWSFG secretariat observations[1]

Document reviewed: **All Nippon Nonwovens Association**	**Due Date:** 2017-09-01

Initials	Line number (e.g. 17)	Clause/ Subclause (e.g. 3.1)	Paragraph/ Figure/ Table/ (e.g. Table 1)	Type of comment[2]	Comments	Proposed change	Observations of the secretariat
Standard 1				Ge	We regard that this "Standard" should be referred to as a "Guideline" of IWSFG. We are opposed to establishing it as the standard. In addition, we are also against the exclusion of regenerated cellulose fibers from the beginning which was based on misinterpretation and misconception. Although we oppose this Standard as stated above, we provide the following comments on rayon (Regenrated Cellulose fibers).	Change the Name “Guideline” Rename this document as “Guideline.”	
PAS1	99	7.2		Ge, Te	The "substrates" in this section should be deleted, since the basic principle stating that plastic lacking biodegradability must not be used, is found in the test procedures.	The "substrates" in this section should be deleted.	
Standard 1 & PAS 1	235 103	7.1.3 7.2.2		Ge, Te	7.1.3,7.2.2 [Regenerated Cellulose Fibers] Rayon is regenerated cellulose fibers made mainly from wood pulp. Therefore, it has a superior biodegradability, and easily decomposes by the bacteria on the ground and in the soil. Even in the event of incineration, it does not produce toxic gas. The rayon, grown as a plant and returned to nature, has not had a major impact on environmental pollution. It is highly safe and also has broadly been used, being acknowledged as eco-friendly recyclable fiber .	Section of Standard-1(7.1.3) and PAS-1(7.2.2) should be deleted.	

1 Adapted from the ISO/IEC Commenting template. 2 Te = Technical, Ge = General, Ed=Editorial

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					Unlike plastic fiber or synthetic fiber such as polyester or nylon fiber, rayon has been identified as a fiber equivalent to pulp in an academia. Hence, section Standard-1 7.1.3 and PAS-1 7.2.2 should be deleted to avoid restricting the use of regenerated cellulose fibers without sufficient scientific rational behind. Regenerated cellulose fibers should be treated equally to pulp in this guideline with following reasons (1) [Confusion between plastic and regenerated cellulose] Throughout this paper, regenerated cellulose has been treated the same as microplastic which is seen as a potential cause to ruin aquatic food chain. Plastics and regenerated cellulose are completely different material from different origin, and various environmental properties such as biodegradability are also completely different. Regenerated cellulose should not be considered in the apossition with plastic. (2) [Pulp used for rayon and toilet paper] It has excellent biodegradability with minimal environmental effect to wastewater. The difference comes from the degree of refinement between pulp and rayon. Rayon		

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					has a higher degree of refinement than pulp, and it biodegrades more rapidly. We completely disagree to restrict regenerated cellulose while, allowing pulp to be contained in wastewater, as rayon biodegrades faster than pulp. (3) [Biodegradability of Regenerated Cellulose Fibers (Rayon)] Regenerated cellulose fibers made from wood pulp have superior biodegradability than pulp which is used as papermaking material. This is because regenerated cellulose fibers have superior biodegradability with a short cellulose chain length, less crystalline, and contain less insoluble impurities. (4) [Regenerated cellulose fibers (rayon) contain little insoluble substance] Rayon is made from pulp which has the highest purity among wood pulp. The rayon fiber is fiber refined from the cellulose of pulp and it contains very little amount of impurities. It contains less impurities and insoluble matter than toilet paper. Also, cellulose has never been identified as a substance that can be categorized as plastic even after refinement, even academically, ever since rayon was introduced.		

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					(5) [Non-toxicity of rayon fiber] No oral toxicity has been found in single dose oral toxicity tests on rats. (6) [Potential contamination from laundry wastewater] It seems that comments on laundry wastewater were made based on wrong interpretation; selectively targeted only rayon while the presence of other fibers such as synthetic fiber are not clearly demonstrated, and microplastic, microfiber and regenerated cellulose are treated as equivalent. With above reasons, we disagree to prohibit the use of regenerated cellulose as substrate.		
Standard 1	235	7.1.3		Ge,Te	Biodegradability of fibers should be addressed through PAS 5A, 5B. if products can pass biodegradability test, why do we need to set restriction on use of Regenerated cellulose fibers?	Delete	
PAS 1	119	7.2.3		Ge, Te	7.2.3 [Test Method] In this test, it is not correct to identify "regenerated cellulose fibers that are made of plastic" as "synthetic".	Please delete "regenerated cellulose fibers that are made of plastic" as "synthetic".	

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Biodegradability of Rayon

August 21, 2017

All Nippon Nonwoven Association

Subject: Comparison of biodegradability between rayon and papermaking pulp as a raw material for hydrolysis paper

1. Characteristics of the biodegradability of rayon
   1) Constituent molecular chain: Molecular chains of constituent cellulose are short, and the breakdown and deterioration of these molecules are faster than pulp. This provides better biodegradability of rayon than pulp.
   2) Crystallinity degree: The crystallinity degree of rayon is low and its amorphous region is larger than pulp, thus water can easily penetrate into the fiber, becoming more swellable than pulp. This provides better biodegradability of rayon than pulp.
   3) Fiber strength: Rayon is a regenerated cellulose, having a larger amorphous region and lower fiber orientation than pulp, thus its fiber strength is lower, which provides better biodegradability than pulp.

2. Consideration

   These characteristics above demonstrate that, in comparison, rayon is actually superior to pulp in terms of biodegradability.

   In general, rayon fiber (fiber length: 5-10mm) used in water-disintegrable nonwoven fabrics has excellent water-disintegrability, dispersibility and biodegradability; therefore, as a problem factor in septic systems, such as in septic tanks, its influence is extremely minimal, and its influence on marine pollution is also minimal (equal to or less than pulp).

   For these reasons, from the viewpoint of drain clearance and marine pollution, while restricting raw materials for hydrolysis paper and establishing regulations on these long and synthetic fibers can be an effective measure for preventing the inhibition of biodegradation, removing rayon fiber as an acceptable raw material for hydrolysis paper would in no way be effective, it can not be a solution to the current problem.

ORIGINAL

Chemicals Evaluation and Research Institute, Japan
CERI Tokyo

Test Report

No.152-17-A-0442

Date: July 11, 2017

1. Client [redacted] Co., Ltd.

2. Accepted Date March 28, 2017

3. Subject Evaluation test of biodegradable plastics (Appearance observation)

4. Sample Unbleached cellulose nonwoven fabric

↖ Regenerated cellulose.

5. Test Method

5.1 Biodegradation treatment by compost

Sample was treated with compost according to JIS K 6953-1:2011 "Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions – Method by analysis of evolved carbon dioxide – Part 1: General method". Sample was buried at about half the height of the compost and was placed in an incubator of 58 °C ± 2 °C

Treatment conditions
- Compost: YK-10 (Yahata Bussan CO., LTD.)
- Culture temperature: 58 °C ± 2 °C
- Treatment period: 63 days
- Sample size: 200 mm × 150 mm

5.2 Appearance observation and weight measurement

63 days treated sample was photographed with a digital camera, after the adhering composts were removed as much as possible. The treated sample was washed by purified water and dried at room temperature and under vacuum. Then the sample weight was measured. Sample surfaces were observed using microscope.

5.3 Morphological observation of fiber by scanning electron microscope (SEM)

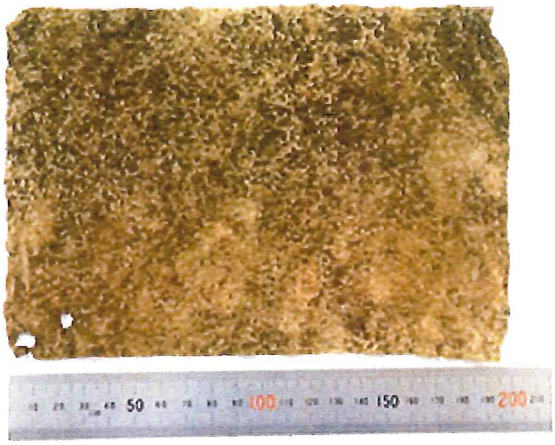
Observation conditions
- Instrument: JEOL JSM-5610LV
- Acceleration voltage: 10 kV
- Sample preparation: gold sputtering
- Specimens: 63 days treated sample, untreated sample

6. Test Result

It was confirmed that the biodegradation of "unbleached cellulose nonwoven fabric" has progressed by treatment with compost. Detailed test results are shown in below sections.

6.1 Appearance observation and weight measurement

Picture 1 shows the appearance of untreated sample, and picture 2 shows the appearance of 63 days treated sample. 63 days treated sample showed brown color overall, and the shallow wrinkles were confirmed. By visual observation, about 9 mm diameter hole, about 7 mm diameter hole, about 0.8 mm diameter hole were confirmed. The decrease of sample weight due to treatment with compost was not detected, the weight of 63 days treated sample was 106 wt% of untreated sample. It was considered that compost particles entered between the fibers of nonwoven fabric, and these cannot removed by wash.



Picture 1: untreated sample

Picture 2: 63 days treated sample (before washed)

The microscopic observation results were shown in picture 3 and 4. Picture 4 was the photo of the vicinity of the hole visually observed on 63 days treated sample.

Picture 3: untreated sample (×30)

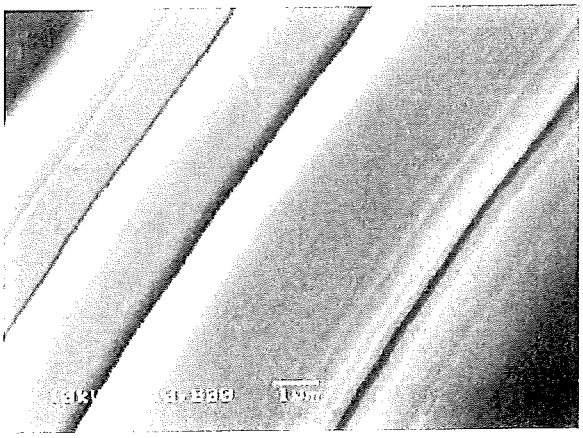
Picture 4: 63 days treated sample (×30)

(See accompanying Figure 1 to 2)

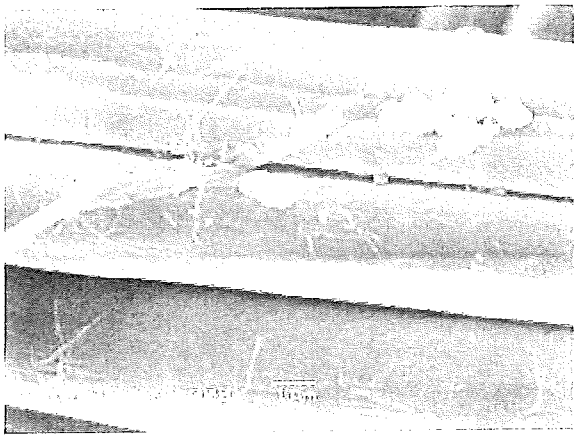
6.2 Morphological observation of fiber by SEM

The morphology of fiber was observed in further detail by SEM.

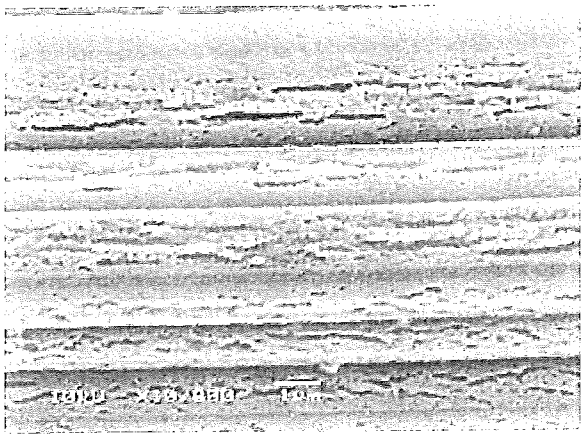
As shown in picture 6, the long extended morphologies and branched ones were observed on the fiber surface of 63 days treated sample. These morphologies were considered to be filamentous fungi. The fiber surfaces of untreated sample were smooth as shown in picture 5. On the other hand, it was observed many small concave forms on the fiber surface of 63 days treated sample (as shown in picture 7), these morphologies were considered to be the eroded traces.



Picture 5: untreated sample (×10000)



Picture 6: 63 days treated sample (×10000)



Picture 7: 63 days treated sample (×10000)

(See accompanying Figure 3 to 9)

(No.152-16-1-1520)

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